

Prerequisites:

1. A passing familiarity with Freshman Calculus.
2. Some ability to program.

Course Description:

This course is an introduction to cyber-physical systems, engineering artifacts in which computational components interact with and typically control physical components. Some common examples of cyber-physical systems include robots, Segways, and lane-departure warning (LDW) systems in automobiles. Since cyber-physical systems involve both physical and computational elements, the field is inherently interdisciplinary, drawing on aspects of software engineering, computer science, mechanical and electrical engineering, and many other disciplines in science and engineering.

The design of cyber-physical systems is a particularly challenging form of software engineering because the behavior of physical components is much more difficult to model accurately than computational components. In this course, students will learn how to analyze and design cyber-physical systems by evaluating and developing high-level executable prototypes of a variety of cyber-physical systems. These prototypes consist of physical elements modeled as hybrid systems using differential equations and computational elements that sense and control the state of the physical elements. The prototyping environment graphically depicts the behavior of the modeled cyber-physical system. The course leads students through a series of more challenging design projects culminating in a major project such as a robot that plays ping-pong.

Course Format:

The course format is primarily Flip Classroom. The video lectures have been supplied by Dr. Walid Taha, University of Holmstead.

To augment the material, however, the instructor will give a lecture a few times during the course,

Detailed Course Lesson Plan:

1. Introduction to Cyber Physical Systems
2. Introduction to the Acumen Modeling System
3. Modeling Continuous Systems
4. Modeling Hybrid Discrete+Continuous Systems
5. Elementary Control Theory
6. Modeling Computer-Augmented Systems
7. Simple Linkages: A single joint Robot Arm Case Study
8. Game Theory
9. Introduction to Smart Grids

NOTE: The undergraduate version of this course, COMP 451, shares the first 8 chapters of this syllabus.